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ENORMITY OF GENETIC VARIABILITY IN AERIAL, UNDERGROUND AND BIOCHEMICAL TRAITS OF ASHWAGANDHA [*WITHANIA SOMNIFERA* (L.) DUNAL]

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ABSTRACT

Present study was carried out to ascertain the extent of genetic variability in the population of 36 different genotypes with respect to aerial, underground and biochemical traits in ashwagandha. The analysis of variance indicates presence of considerable amount of variability in the population of the genotypes. The high genotypic coefficient of variation (GCV%) was observed for total alkaloid content (37.38 %) and total withanolides content (22.80%). High heritability estimates were observed for days to maturity (94.0%), total alkaloid content (91.0 %), days to flowering (82.0%) and plant height (70.0%). The traits such as total alkaloid content, total withanolides content, main root length and plant height also exhibited high to moderate GCV (%), heritability as well as genetic advance (GA), hence these traits being governed by additive gene action. The breeding methods such as selection would be effective for genetic improvement of these traits.

KEYWORDS: Withania Somnifera, Genetic Variability, Heritability, Genetic Advance and Withanolids Content

INTRODUCTION

Ashwagandha (*With ania somnifera* (L.) Dunal) is an ancient medicinal plant with immense therapeutic uses in traditional (Ayurveda, Sidhdha and Unani) and modern system of medicine. Ashwagangha roots are used in ayurvedic and unani medicines. The roots have several alkaloids and with an olids. The total alkaloids content of the roots varies from 0.16 to 0.66 per cent (Biennial Progress Report, 2006-08). As mentioned in ayurvedic texts including charak samhita and sushrut samhita, roots are used as general tonic as well as cure for morbidity arising from diseases such as pain, arthritis and inflammation (Dash and Junius, 1983). It acts mainly on the reproductive and nervous systems, having a rejuvenative effect on the body, and is used to improve vitality and aid recovery after chronic illness (Bown, 1995; Chevallier, 1996).

In India, very few cultivars are developed and a little research work has been done on the genetic improvement aspect of this crop. For developing high yielding varieties a systematic approach has to be adopted. Assessment of variability in available germplasm is most important as well as first step of any breeding programme. Greater the variability in the genetic material more chances of genetic improvement. The selection is more effective when it is practiced simultaneously for the characters which have desired nature of association with the traits of ultimate interest. In sight of beyond the truth, the here study was done to evaluation of enormity of variability in aerial, underground and biochemical traits by computing various parameters like GCV, PCV, heritability and expected genetic gain in ashwagandha.

MATERIAL AND METHODS

The experiment was performed to evaluate 36 different single plant progenies of individual genotypes (Table 1) at Department of Genetics and Plant Breeding, Chimanbhai Patel College of Agriculture, S. D. Agricultural University, Sardarkrushinagar during *rabi* season of 2014-15. The observation on five randomly selected plants were recorded for days to flowering, days to maturity, plant height, number of primary branches per plant, stem diameter (mm), main root diameter (mm), main root length (cm), main dry root weight (g), total alkaloid content (%) and total withanolides content (g/100g of roots). Total alkaloid content was analyzed by quick method of estimation of total alkaloid given by Mishra (1998) and total withanolides content of each extract was determine by the modified spectrophotometer method developed by Mishra (1994). Analysis of variance was calculated with the method suggested by Panse and Sukhatme, 1978. The genotypic and phenotypic coefficient of variation (GCV and PCV) were estimated as per Burton, 1953, while classification of GCV and PCV were followed by Sivasubramanian and Madhavamenon, 1973. Heritability in the broad sense and genetic advance (GA), suggested by Allard, 1960 and genetic gain expressed as a percentage of mean were computed according to Johnson *et al.*, 1955.

RESULTS AND DISCUSSIONS

The analysis of variance revealed the existence of considerable genetic differences among the genotypes for all the traits (Table 2). This indicated suitability of experimental material for estimation of genetic parameters. The genotypic variation for main dry root weight per plant was highly significant among all the genotypes. Mean value for dry root weight ranged from 0.66 g (MWS-329-2-2) to 1.99 g (MPAS-3-3-1). The overall mean was estimated as 1.15 g. The estimates of phenotypic, genotypic and environment variance were 0.03, 0.19 and 0.15, respectively (Table 3).

The phenotypic range of variation is not the precise criterion to estimate the amount of genetic variability present in a breeding population. The other genetic parameters such as variance components, genotypic coefficient of variation, heritability and genetic advance are important to get an idea about the extent of genetic variability more precisely. The phenotypic variance was partitioned into its genotypic and environmental components. Genotypic component of variance was higher than environmental component for all the traits indicating phenotypic variability was a reliable measure of genotypic variability. Therefore, selection would be effective for these characters. High to medium estimates of genotypic and phenotypic variances were observed for days to flowering and plant height, (Table 3). Similar finding were also reported by Mohsina and Datta (2007) for plant height, Sundesha and Tank (2013) for days to maturity and plant height.

Moderate to low estimates of genotypic variance were recorded for days to flowering (8.17), main root length (2.73), main root diameter (0.70), stem diameter (0.18), number of primary branches per plant (0.08), main dry root weight (0.03), total alkaloid content (0.02) and total withanolides content (0.01) (Table.3) The results were conformity with those obtained by Dubey (2010), Das *et al.*(2011) and Sundesha and Tank (2013) Thus, the variation in majority of the yield contributory traits was under genetic control. Hence, selection for these traits population studied would be effective for its improvement. However, these genotypic, phenotypic and environmental variances components do not provide an exact measurement of variation for its comparison among the characters because they are based on different units of measurements having different means. Hence, genotypic coefficient of variation and phenotypic coefficient of variation were computed to compare variability of various traits.

The high genotypic coefficient of variation (GCV %) was observed for total alkaloid content (37.38 %) and total withanolides content (22.80%). While it was moderate for plant height (18.65 %), main dry root weight (15.84%), stem diameter (10.90%), main root length (10.75%) and root diameter (10.65%) (Table 4). Such level of GCV (%) was also reported by Dubey (2010) for dry root yield, root length, root diameter, plant height, number of primary branches per plant and days to maturity. Nilesh *et al* (2014) for dry weight of root and withanolides content. The differences between GCV and PCV were low for all the traits, which indicated that environment played very little role for expression of traits.

Heritability indicates the effectiveness of selection of genotypes which could be based on phenotypic performance. The expected genetic advance under selection gives clear idea of possible change in mean value in the generation following selection. High heritability estimates were observed for days to maturity (94.0%), total alkaloid content (91.0 %), days to flowering (82.0%) and plant height (70.0%). Whereas traits like total withanolides content (41.80%) and root length (33.0%) had moderate heritability and root diameter (27.0%), stem diameter (24.0%), main dry root weight (18.0 %) and number of primary branches per plant (18.0%) confined low heritability. Similar trend was also observed by Yadav *et. al.*(2008), Dubey (2010) and Sundesha and Tank (2013).

High heritability coupled with high genetic gain was observed for plant height and total alkaloid content revealed that these traits are governed by additive genes. Same level of results also confirmed by Das *et al.*(2011) for total alkaloid content. Thus, the substantial contribution of additives genetic variance in the expression of these traits is evident and, therefore, these traits could be improved through individual plant selection.

Moderate heritability coupled with high genetic advance as per cent of mean observed for total withanolides content and moderate heritability coupled with moderate GA (%) and moderate GCV (%) observed in case of main root length, indicated that genotype under study were diverse with appreciable genetic potential and further improvement in these traits is possible by practicing simple selection.

CONCLUSIONS

The traits such as total alkaloid content, total withanolides content, main root length, plant height exhibited high to moderate GCV (%), heritability as well as genetic advance (GA), hence these traits being governed by additive gene action, the breeding methods such as simple selection which make use of additive genetic variance would be effective for genetic improvement of these traits.

REFERENCES

1. Allard, R.W., (1960). Principles of Plant Breeding. John Willey and Sons. Inc., New York.
2. Biennial Progress Report (2006-08). Proceeding of Seventeenth Group Meeting of All India Networking Research Project on Medicinal &Aromatic Plants. NRC on Medicinal & Aromatic plant, held at KAU Trichur, November 15-18.
3. Bown, D. (1995). *Encyclopaedia of Herbs and their Uses.* Dorling Kindersley, London.
4. Burton, G.W., (1952). Quantitative inheritance in grasses Proc. 6th Int. Grass Cong., 1: 227-283.
5. Chevallier, A. (1996). *The Encyclopedia of Medicinal Plants* Dorling Kindersley. London.
6. Das, A., Datta, A. K., Ghosh S. and Bhattacharya, A. (2011). Genetic Amnalysis in Poshita and Jawahar 22

Varieties of *Wthania somnifera* (L.) Dunal (Solanceae). *Plant Archive.* **11**(1): 59-62

7. Dash, V.B. and Junius, A.M. (1983). A Handbook of Ayurveda. *Concept Publishing*, New Delhi. 15-25.
8. Dubey, R. B. (2010). Genetic variability, correlation and path analysis in ashwagandha (*Withania somnifera*). *Journal of Medicinal and Aromatic Plant Sciences.* **32**: 3, 202-205. 8.
9. Johnson, H.W., H.F. Robinson and R.E. Comstock, (1955). Estimation of genetic and and environmental variability in soybean. *Agron. J.* **47**: 314-318.
10. Mishra, (1994). Calorimetric method for estimation of total withanolides. 10th All India Workshop Report on *Medical and Aromatic Plants* held at Trichur. pp. 379-381
11. Mishra, S.N. (1998). Quick methods of estimation of total alkaloid (All India Co-ordinated Research Project on Medicinal and Aromatic plants, presentation of trial data at C.C.S. Haryana Agricultural University, Hissar) (Oct.27-30, 1998).
12. Mohsina-Iqbal and Datta, A. K. (2007). Genetic variability, correlation and path analysis in *Withania somnifera* (L.) Dunal. (Ashwagandha). *Journal of Phytological Research*. **20**(1): 119-122.
13. Nilesh R Joshi, Patel M.A, Prajapati K.N and Patel A.D. (2014). Genetic variability, correlation and path analysis in ashwagandha (*Withania somnifera* (L) Dunal). Electronic Journal of Plant Breeding. **5**: 4, 875-880.
14. Panse, V.G. and P.V., Sukhatme, (1978). Statistical methods for agricultural workers (II Edn.). I.C.A.R. Publication, New Delhi.
15. Sivasubramanian S. and Madhavamenon P. (1973). Genetic analysis of quantitative characters in rice through diallel crosses. *Madras Agric J.* **60**:1097-1102.
16. Sundesha D.L and Tank C.J. 2013. Genetic variability, heritability and expected genetic gain for dry root yield in ashwagandha (*Withania somnifera*). Asian *Journal of horticulture.* **8**: 2, 475-477.
17. Yadav, O. P.; Kumar, Y. and Verma P. K. (2008). Genetic variability, association among metric traits and path coefficient analysis in ashwagandha (*Withania somnifera*). *Haryana Agricultural University Journal of Research.* **38**: 1/2, 23-26. 7.

APPENDICES

Table 1: List of Single Plant Progeny of Individual 36 Genotypes Evaluated for Variability

Sr. No.	Genotypes	Sr. No.	Genotypes	Sr. No.	Genotypes	Sr. No.	Genotypes
1.	MWS-316-2-1	10	MWS-309-3-1	19	RAS -33-1-1	28	MPAS-7-3-1
2.	MWS-226-2-1	11	MWS-101-3-2	20	RAS- 11-3-2	29	MPAS-7-4-1
3.	MWS-226-2-2	12	MWS-208-3-1	21	RAS -55-4-2	30	MPAS-10-1-1
4.	MWS-205-3-2	13	MWS-208-4-1	22	RAS-29-1-2	31	MPAS-12-2-1
5.	MWS-322-1-2	14	RAS-18-1-1	23	RAS-29-3-1	32	MPAS-15-3-1
6.	MWS-322-2-2	15	RAS -16-4-1	24	MPAS-3-3-1	33	MPAS-16-1-1
7.	MWS-302-4-2	16	RAS -21-2-1	25	MPAS-4-1-2	34	IC 286632-3-1
8.	MWS-217-2-1	17	RAS -23-2-1	26	MPAS-5-4-1	35	IC 283662-1-1
9.	MWS-329-2-2	18	RAS -15-2-2	27	MPAS-7-1-1	36	IC 283662-1-2

Table 2: Analysis of Variance (ANOVA) Showing Mean Squares of Different in Ashwagandha

Source of Variation	D.F.	Days to Flowering	Days to Maturity	Plant Height (Cm)	No. of Primary Branches	Stem Diameter (Mm)	Main Root Diameter (Mm)	Main Root Length (Cm)	Dry Root Weight Per Plant (Gm)	Total Alkaloid Content (%)	Total With anolides Content (G/100g)
Replication	2	1.75	7.79	9.40	0.16	1.27	5.66	16.58	0.30	0.001	0.002
Genotypes	35	26.31***	174.83**	150.36**	0.61**	1.12**	3.98**	13.66**	0.25**	0.063**	0.004**
Error	70	1.81	3.67	18.66	0.37	0.57	1.89	5.46	0.15	0.001	0.001
S.Em.±		0.78	1.11	2.49	0.35	0.44	0.79	1.35	0.23	0.03	0.02
C.D. at 5%		2.19	3.12	7.03	0.99	1.23	2.24	3.80	0.64	0.07	0.06
C.V. %		1.63	1.19	12.16	18.24	19.36	17.54	15.18	34.08	11.58	27.31

*,** Significant at 5 % and 1% level respectively

Table 3: Range, Mean and Components of Variances of Various Character in Ashwagandha

Characters	Range	Mean	Components of Variance		
			Genotypic	Phenotypic	Environmental
Days to flowering	76.00-89.00	82.47	8.17	9.97	1.81
Days to maturity	148.00-179.00	160.98	57.06	60.73	3.67
Plant height (cm)	26.60-62.53	35.53	43.90	62.56	18.66
No. of primary branches	2.13-4.40	3.34	0.08	0.45	0.37
Stem diameter (mm)	2.44-5.14	3.91	0.18	0.76	0.57
Main root diameter (mm)	5.26-10.50	7.84	0.70	2.59	1.89
Main root length (cm)	11.80-21.05	15.39	2.73	8.19	5.46
Main dry root weight Per plant (gm)	0.65-1.99	1.15	0.03	0.19	0.15
Total alkaloid content	0.10-0.70	0.38	0.02	0.02	0.00
Total Withanolides content (g/100g)	0.10-0.30	0.15	0.01	0.01	0.00

Table 4: Genotypic and Phenotypic Coefficient of Variation, Heritability, Expected Genetic Advance and Genetic Advance in Per Cent of Mean for Different Characters in Ashwagandha

S.No	Characters	Genotypic Coefficient of Variation (GCV %)	Phenotypic Coefficient of Variation (PCV %)	Heritability (Broad Sense %)	Expected Genetic Advance	Genetic Advance in Per Cent of Mean
1	Days to flowering	3.47	3.83	82.00	5.33	6.46
2	Days to maturity	4.69	4.84	94.00	15.08	9.37
3	Plant height (cm)	18.65	22.26	70.00	11.43	32.18
4	No. of primary branches	8.45	20.10	18.00	0.24	7.32
5	Stem diameter (mm)	10.90	22.22	24.00	0.43	11.01
6	Root diameter (mm)	10.65	20.52	27.00	0.89	11.39
7	Root length (cm)	10.75	18.60	33.00	1.97	12.79
8	Dry root weight per plant (gm)	15.84	37.58	18.00	0.16	13.76
9	Total alkaloid content	37.38	39.14	91.00	0.28	73.56
10	Total Withanolides content (g/100g)	22.80	35.57	41.80	0.04	30.10